REMARKS

It is believed that each of the Objections to the claims raised by the Examiner on pages 3 and 4, and the claim rejections under 35 U.S.C. §112 on pages 4 and 5 of the Office Letter have been addressed and obviated by the amended claims. The adopted language in the introductory clause of claim 1, the sole independent claim, finds basis at the bottom of page 7 of applicants' specifications.

Examiner is respectfully requested to reconsider and to withdraw the rejection of claims 1-9 and 11 under 35 U.S.C. 103(a) as being unpatentable over Copenhafer '054 in view of Dome '882 in view of the amended claims and for the following reasons which distinguish the claims from the combination rejections based on those references.

Examiner is respectfully requested to reconsider and to withdraw the rejection of claims 1,2, 4-9 and 11 under 35 U.S.C. 103(a) as being upatentable over Frint '134 in view of Dome '882 for the following reasons.

The present invention provides an economically novel system for recovering sodium carbonate values by introducing and controlling the concentration of various feed sources and concentration of sodium carbonate or sodium bicarbonate bearing streams at several points without incurring additional evaporative concentration energy and/or neutralization costs.

None of the prior art known or the prior art cited and relied upon by the Examiner discloses or teaches that claimed invention nor the capability to achieve a comparable system that affords the flexibility and energy conservation of the present invention. The prior art systems are clearly distinguishable for the reasons which follow.

Copenhafer '054, as well as Frint '134 and Smith '499 do not disclose a system suitable for sodium carbonate waste recovery and Dome '882 is not suitable for resolving a product from a waste stream having less that 14 percent sodium carbonate.

The system of these cited references are additionally distinguishable for the following reasons.

Copenhafer it is seen does not recover sodium carbonate values from purge streams; in that reference, the purge stream is wasted. In other words, Copenhafer is not concerned with the concentration of less concentrated streams nor does the Copenhafer

process feed purge streams to a decahydrate unit to recover sodium carbonate values. The entire volume of mother liquor is fed to a decahydrate unit (a significant cost disadvantage compared to cooling only a purge stream) rather than recycling back to the monohydrate evaporator. The process of the present invention on the other hand, as recited in step d of claim 1, recycles the mother liquor from the monohydrate crystallizer to the crystallizer, avoiding these costs.

In Copenhafer, as well as, in Frint and Dome it is necessary to cool the entire brine stream to crystallize the sodium carbonate decahydrate and recover the sodium carbonate values. In those systems, the introduction of other waste streams to the processes will result in liquor concentrations not suitable for economic sodium carbonate recovery using the sodium carbonate decahydrate units disclosed by the patentees, i.e., the sodium carbonate concentration will be too low, requiring further evaporation, or will be too concentrated in sodium bicarbonate, requiring introduction of the waste stream prior to stream stripping and neutralization. Introduction of other waste streams, including monohydrate purge as in the Smith system would elevate impurities to levels not suitable for feed to a monohydrate evaporator unit.

In the invention as in step e, the waste streams are concentrated by dissolving natural sodium carbonate deposits in surface evaporation ponds. Other waste streams are concentrated using monohydrate evaporator purge liquor. Evaporation is not used in the process to concentrate low sodium carbonate bearing streams. Sodium carbonate decahydrate is formed to physically separate sodium carbonate from impurities resident in the waste streams. The pure crystals are added to the monohydrate feed liquor to recover the sodium carbonate from the waste streams and process it into soda ash. In the invention sodium bicarbonate bearing waste streams are introduced at two points depending on the concentration which is determined by the proportional mixing of various waste streams. That portion of the waste stream containing higher concentrations of sodium bicarbonate is neutralized using causticization. The remaining portion of the system of the invention with lower sodium bicarbonate concentrations is steam stripped prior to feeding a monohydrate evaporator or else diluted by other sodium carbonate containing streams prior to feeding a sodium carbonate decahydrate unit. This is unlike Copenhafer, as well as, Frint or Smith which must steam strip and causticize the entire

brine volume at a significant economic cost disadvantage. Neither the system of Copenhafer nor that of or Dome, (as well as those of Frint or Smith) can suitably accept a dilute waste stream introduced to the feed stream just prior to the sodium carbonate decahydrate unit because the mixed liquor would have too low a sodium carbonate concentration, and in the case of Smith, too high an impurity level. The processes described by Copenhafer, Frint, and Smith, it should be noted, are fixed by the equilibrium concentration defined by the sodium carbonate-sodium bicarbonate-water system. The systems of those patentees differ in that waste streams can only be introduced prior to the steam stripping and concentrating step, otherwise the sodium carbonate concentration is too low or the sodium bicarbonate concentration is too high to suitably feed the sodium sesquicarbonate, sodium carbonate decahydrate, or sodium carbonate monohydrate crystallizers. Introduction into the starting brine necessarily increases energy costs for steam stripping, evaporation and neutralization, with additional causticization agent costs. The process claimed by the present invention on the other hand is not restrained by the introduction point or the concentration of the waste stream introduced, and the energy and neutralization costs are minimized by combining the various waste streams. Such flexibility is not available in the systems of Copenhafer, Dome, Frint or Smith.

The invention, it is submitted, provides a system with the flexibility to selectively mix and introduce various sodium carbonate/sodium bicarbonate bearing streams to suitably feed a sodium carbonate decahydrate or monohydrate crystallizer. The system for recovery of sodium value is not restrained by sodium carbonate-sodium bicarbonate-water system equilibrium which is not true for the systems disclosed by the cited prior art patentees.

In the invention, a wide range of sodium carbonate feed concentrations can be readily accommodated because of the availability of two independent operable steps, i.e., via sodium carbonate monohydrate or via sodium carbonate decahydrate. In Copenhafer, as well as, in Frint and Smith, the initial brine composition is a solution that is saturated with both sodium carbonate and sodium bicarbonate at the dissolving temperature. Sequential crystallization is required to recover sodium values from the initial brine steams and results in depleted mother liquor whose composition is defined by the sodium

carbonate-sodium bicarbonate-water system that is fixed by cooling the saturated initial brine stream. In those prior art systems the composition of the mother liquor fixes the unit operation that must follow the sodium decahydrate recovery.

In the system of the invention the mother liquor from the sodium carbonate monohydrate evaporator is recycled back to the unit taking advantage of hot saturated brine whereas Copenhafer must cool and crystallize sodium carbonate decahydrate from the entire mother liquor stream to avoid lowering the concentration of the initial brine stream which are steps that add a significant cost disadvantage. Copenhafer cannot recycle the mother liquor stream back to the monohydrate crystallizer.

Referring to the rejection under 35 USC 103(a) of the claims based on Frint in view of Dome it is seen that Frint depletes the sodium carbonate concentration coincidentally with the bicarbonate concentration in the initial brine by crystallizing sodium sesquicarbonate as the second decarbonization step. This results in mother liquor too lean in sodium carbonate to feed a monohydrate crystallizer. Therefore, the entire volume of this feed stream must be cooled to recover sodium carbonate decahydrate at a significant cost disadvantage. The purge stream in Frint is wasted. Frint does not introduce waste purge streams from which sodium carbonate values can be recovered using a sodium carbonate decahydrate unit, nor does the process describe methods for concentrating less concentrated streams prior to feeding a sodium decahydrate process. The sodium value resident in the sesquicarbonate mother liquor sodium value can only be economically recovered using a sodium carbonate decahydrate unit following in sequence, the sodium sesquicarbonate process. The entire mother liquor stream employed by the patentee must be cooled a costly operation that is avoided by the system of the invention.

With reference to the rejection of the under 35 USC 103(a) based on Smith in view of Dome it is seen that Smith cannot recycle the entire portion of monohydrate mother liquor back to the crystallizer because of elevated impurity levels. It cannot recycle any portion of the monohydrate purge liquor. Therefore, the remaining portion of the mother liquor must be cooled to sodium decahydrate crystals and recover the sodium value of the monohydrate mother liquor at a significant cost disadvantage. The unrecoverable sodium value in the monohydrate purge stream represents a second cost

disadvantage compared to the process of Claim 1. The process of Smith can not tolerate the introduction of a purge stream in its sodium carbonate stream as evidenced by the fact that the purge stream of the monohydrate process is wasted. Consequently sodium values are not recoverable as is effected by the process of the present invention.

Alluding to the secondary reference to Dome which has been combined in the systems respectively with Copenhafer, and with Frint and Smith respectively, the compatibility of the combination made in the light of applicants' disclosure is questioned. In any event it is seen that Dome contrary to the claimed invention recovers sodium carbonate values from waste streams typically containing 7-14% equivalent soda ash that is cooled by evaporation producing effluent liquor containing 17-24% soda ash, whereby 10% of this stream is crystallized as decahydrate. In the invention on the other hand the recovery of sodium carbonate values from lesser bearing waste streams employs a different process i.e., Dome requires evaporative cooling to concentrate lesser sodium carbonate bearing streams prior to feeding a decahydrate crystallizer; this is a distinctive and expensive operation not utilized by the invention.

In essence it is submitted that the invention introduces a novel process for the recovery of sodium carbonate values from various waste streams including waste waters, monohydrate evaporator purge, surface evaporation pond deposits, mine waters, etc. by combining the various streams minimizing steam stripping, evaporation, and neutralization costs of the kind that cannot be avoided Copenhafer, Frint, or Smith in combination with Dome. Unlike each of the pri9mary references the sodium carbonate value of the feed stream of the present invention can be adjusted to suitably feed either a decahydrate or monohydrate recovery unit and does not require additional neutralization/evaporation of the entire recovery stream, a significant economic advantage.

In the invention all of the soluble impurities introduced into the process via waste streams in the sodium carbonate decahydrate process are concentrated and converted to soda ash. This is distinctively different from Copenhafer, Frint, and Smith, none-of-which recover sodium carbonate values from waste streams introduced into the process. The invention also involves a recovery of sodium carbonate from waste streams, not trona-dissolved derived streams. The waste streams and sodium carbonate decahydrate

recovered are obtained at a significant economic advantage and provide flexibility in employment of those streams.

It is accordingly submitted that the invention provides a distinctly novel system for the economical recovery of waste stream sodium carbonate values that result in a significantly lesser volume of wastes reporting to evaporation ponds, or that would otherwise be disposed and by a means not disclosed or taught by the cited prior art.

In view of the foregoing amendment of the claims and remarks distinguishing the cited prior art from the claimed invention Examiner is respectfully requested to reconsider and to withdraw the grounds of rejection and to allow the claims.

Respectfully submitted,

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